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G. C. Wallich M.D. – megalomaniac or mis-used oceanographic genius?

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The importance of the voyage of HMS *Challenger* (1872–76) in the development of oceanography is now universally recognised, and few marine scientists would wish to belittle the contributions made by the relatively small group of men directly involved in the undertaking. But though the exploration of the deep sea in the 1870s captured the public imagination much as did space exploration in the 1960s, and honours were showered on the main *Challenger* personalities after the ship's return to England, the venture was, perhaps inevitably, not without its critics.

The major public controversies which developed over such matters as the cost of the expedition, Wyville Thomson's decision to send some of the material collected during the voyage to foreign scientists rather than have it worked up entirely at home, and the delay in publication of Murray's coral reef work, which seemed to refute Darwin's earlier theory of reef formation, are all well known.[1] But scientists being no less prone to human frailty than any other section of the community, there must have been many a biologist, geologist, or chemist who, while of necessity joining in the general acclamation of the major new discoveries, was secretly envious of the limelight in which he saw his *Challenger* colleagues bathed and resentful of the opportunities and recognition that chance or lack of the right connections had denied him.

Such a critic, not of the *Challenger* enterprise itself, but certainly of several of the scientists, was George Charles Wallich M.D., whose grievances, particularly against Wyville Thomson and W. B. Carpenter, were brought to a head by the publication, in 1877, of Thomson's two volumes on the work of the *Challenger* in the Atlantic,[2] though a smouldering enmity against the two eminent figures had been slowly intensifying over the previous decade.

Although Carpenter and Wyville Thomson were undoubtedly Wallich's particular 'bêtes noires', he was catholic in his criticism of his contemporaries and took up his pen against all manner of opponents, including some of the most revered scientists of his day.

Wallich's criticisms were mainly based on his claim that his own oceanographic work was frequently either overlooked or given insufficient recognition by later workers, but in these instances, and particularly in the case of Carpenter and Wyville Thomson, he added

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the much more serious charge of plagiarism. These charges were fairly explicitly stated some of his published papers, so that his contemporary readers would have been familiar with his views. But even in an age when scientists were generally much more forthright, and perhaps less hypocritical, in their public opinions of their colleagues than we are today, there were nevertheless strict limits to how far he could go in print. The real depth of his bitterness therefore becomes apparent only in his previously unpublished comments, some of which are preserved in the libraries of the British Museum (Natu History), the Wellcome Institue of the History of Medicine, and the Royal Society.[3] In historical accounts of the growth of oceanography Wallich usually receives no more than a passing reference in connection with a single cruise in 1860, almost as if he h suddenly appeared upon the marine scientific scene immediately before this and mysteriously disappeared shortly after it. His serious interest in marine biology certai did begin somewhat abruptly in his mid 40s, but his manuscripts reveal that he maintained his interest for the rest of his long life and that for over 30 years it was dominated by a fascinating, though jaundiced, opinion of the Victorian scientific establishment.

For the purposes of this paper Wallich's life can be divided into four main parts, the first ending with his retirement from his medical career, the second covering the blossoming of a new career in marine biology, the third dominated by fairly intense public criticism, and the last being a period of private frustration.

1. 1815–1859: THE FIRST CAREER AND THE BIRTH OF A SECOND

Wallich was born in 1815 in Calcutta where his Danish father, Nathaniel Wallich FRS (1786–1854), the celebrated botanist, was Superintendent of the Botanical Gardens. The young Wallich was educated at King's College Aberdeen and the University of Edinburgh where he graduated with an M.D. in 1836, becoming a Licentiate of the Royal College of Surgeons of Edinburgh in the following year.

In 1838 he returned to India as an Assistant Surgeon in the Indian Army and saw considerable active service during the next 19 years, taking part in the Sutlej and Punjab campaigns of 1842 and 1847 and acting as field surgeon during the Sonthal rebellion of 1855–56.[4]

During his military service Wallich apparently made only one visit to England, travelling from Calcutta to Portsmouth on the *Prince of Wales* between February and June 1850, and returning to India the following year, leaving Portsmouth on August 20th and reaching Calcutta in mid December. In the course of these voyages Wallich showed the beginnings of his interest in oceanography, for during the weeks and months on board he collected and sketched a variety of organisms which he encountered in the surface waters through which the ship passed.[3]

Although some of these sketches are quite good, they are very inferior to the results of his final voyage from India in 1857 (*see* Fig. 1) when he was invalided out of the army with the rank of Surgeon Major. On March 7th he left Calcutta with his wife and three children[5] on the *Queen*, a 1500 ton merchantman, and before reaching England in July he had experienced "peculiarly favorable circumstances to the microscopist, though not so to the navigator; inasmuch as frequent calms, both in the Bay of Bengal, Indian Ocean, on the Agulhas Bank to the southward of the Cape, at St Helena, and off the

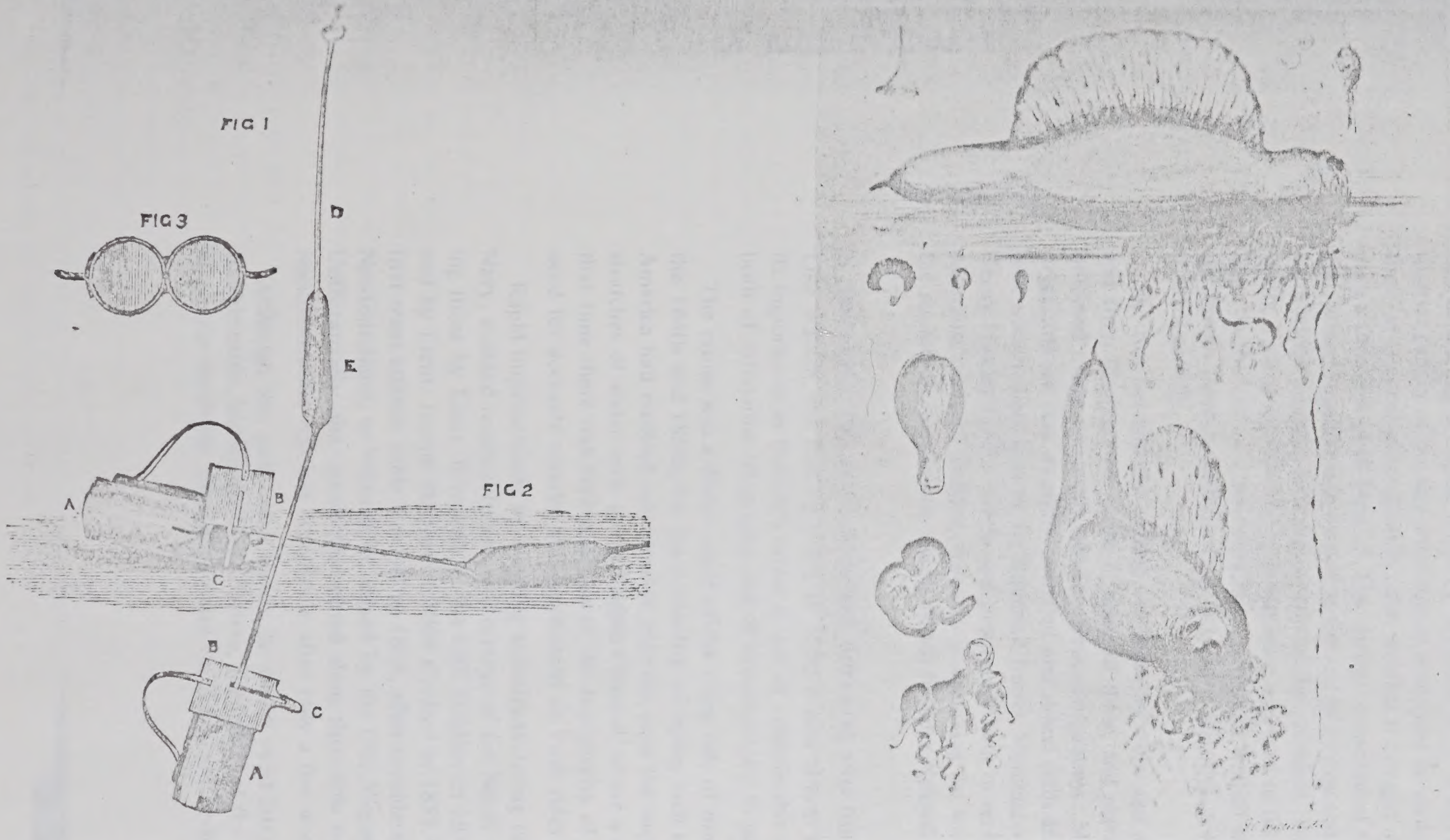

Fig. 1. (Right). Watercoloured drawing of a Portuguese man-o-war, *Physalia*, made by Wallich during his final return from India aboard the *Queen* in 1857, reproduced by permission of the Trustees of the British Museum (Natural History). (Left). Wallich's dredge used from the *Queen*, reproduced from Wallich (1859) (see Note 6).

Western Isles, afforded constant opportunities for using the casting net, towing net, or dredge, as the case might be."[5]

The tow-net was by this time in fairly common use, but the casting net and dredge alluded to were Wallich's own innovations, at least for these purposes.

The casting net consisted simply of a hoop of ½ inch iron rod about 2′ 8″ in diameter and with a bag of coarse 'crinoline' attached to it. It was thrown like a quoit from the quarter gallery of the ship over objects seen close beneath the sea surface and was so effective that "at one cast in moderately calm weather it brought up a couple of open-sea mackerel, each a foot and a half long".[7] The 'dredge' consisted of two copper cylinders, closed at one end, joined together side by side at the end of an iron rod and closed by a spring-loaded plate which moved across the mouths of the cylinders. Wallich's ideas are clearly explained in Fig. 1, showing how the cylinders were expected to fill up with bottom material when used on the end of a sounding line. Although Wallich says that he used the dredge from the *Queen* there is no indication as to how effective it was and he did not apparently use it subsequently.

The tow-net and the casting net, however, collected numerous macroscopic organisms and from the digestive tracts of some of these, and particularly from the salps, Wallich obtained many previously unknown micro-organisms. Many of his drawings of these organisms are very expertly executed and reveal skills as an observer and artist which must have commended him to Sir Roderick Impey Murchison (1792–1871) and Thomas Henry Huxley (1825–1895) and prompted them to recommend his appointment as naturalist on HMS *Bulldog,* the only undertaking for which he is usually remembered and the source of most of the results which he later claimed were either ignored or plagiarised.

2. 1860–1868: THE VOYAGE OF THE BULLDOG AND THE PUBLICATION OF THE RESULTS

Like Wallich, the *Bulldog* cruise of 1860 is now almost totally forgotten, but apart from its importance in Wallich's career it was of considerable significance in the development both of submarine telegraphy and of oceanography in general.

The cruise was a direct result of the rising tide of interest in submarine cables during the 1840s and 1850s, for the possibility of laying such a cable to link Europe and north America had received considerable impetus from the successful operations over narrower stretches of water such as the English Channel, where a cable had been laid in 1851. At that time there was little real idea of the topography of the great ocean basins and the need for accurate surveys was appreciated on both sides of the Atlantic.

Rapid improvements in sounding techniques during the 1850s, particularly by the U.S. Navy, enabled reasonably accurate surveys of the North Atlantic to be carried out, including those by Lieut. Berryman in the USS *Dolphin* in 1853[8] and the USS *Arctic* in 1856,[9] and by Lieut. Joseph Dayman in HMS *Cyclops* in 1857.[10] Following these surveys the first trans-atlantic cable was laid in 1858, after considerable difficulties, from Trinity Bay, Newfoundland, to Valencia in Ireland by the USS *Niagara* and HMS *Agamemnon.* Unfortunately, the signals transmitted along this cable were poor from the outset and communication was lost completely after only a few weeks.

Although this same route was to be used 9 years later for the first successful trans-atlantic cable, laid by the *Great Eastern,* the failure of the 1858 cable encouraged supporters of a more northerly alternative route via Greenland, Iceland and the Faröes. For the

mechanical difficulties in laying a cable beneath several thousands of miles of open sea, coupled with Faraday's elucidation in 1853 of the problems in transmitting electrical impulses along very long wires, prompted some people to favour shorter marine sections with intervening overland cables where this was possible. The case for this approach to the Atlantic cable was forcefully argued by the American, Colonel Taliaferro Preston Shaffner, from 1854 onwards both in North America and in Europe. Shaffner initially investigated the possibility of taking the European end of the cable from the Faröes to Norway and thence to Copenhagen, but after the failure of the Newfoundland to Ireland cable he favoured the shorter terminal leg from the Faröes to Scotland. During 1859 he personally carried out a preliminary survey of the proposed route in a chartered sailing vessel and made the results public when he landed in Glasgow in November of that year. On May 15th 1860 the promoters of the northern route, including several members of Parliament (and, according to a manuscript note, George Wallich himself),[11] approached the Prime Minister, Lord Palmerston, and obtained Government support for the necessary detailed surveys. With the compliance of the Hydrographer, Capt. John Washington, the British Admiralty was to survey the deep-sea portions of the route, while the telegraph company took responsibility for the coastal and overland sections.

The obvious officer to undertake the naval surveys was Lieut. Dayman who, in addition to his sounding cruise in the *Cyclops* in 1857, had made similar surveys in the *Gorgon* from Cape Race to Fayal in the Azores and on to the English Channel in 1858, and across the Bay of Biscay and into the Mediterranean in the *Firebrand* in 1859.[12] But despite this experience Dayman was passed over and the Hydrographer approached instead Captain Sir Leopold M'Clintock, possibly because of his considerable arctic experience. But the Hydrographer's choice may also have been influenced by the fact that since he had returned home in 1859 with the news of the fate of Sir John Franklin's expedition[13] M'Clintock had become a national figure and it would have been difficult to leave him on half pay![14, 15]

The ship chosen for the survey was HMS *Bulldog* (Fig. 2), a paddle steamer of 1148 tons, 15′ 8″ draft and 500 h.p.[16] Lord Ashburton, the President of the Royal Geographical Society, said that the ship was equipped in the most efficient manner, but Sir Clements Markham, who was M'Clintock's biographer,[17] thought that the Admiralty would have found a better vessel. However, a glance at the *Navy List* shows that other vessels of sufficient power were either on other stations or were building at the time.

The *Bulldog* was supplied with a variety of sounding gear for two quite distinct techniques. Firstly, to record the depth alone M'Clintock was to lower heavy weights on fine cod-line of which he took 75,000 fathoms. Since this line was not strong enough to bring up the weights these were invariably lost and large numbers therefore had to be carried.[18]

For obtaining samples of the sea-bed, on the other hand, M'Clintock was given ten sets of the sounding apparatus which had been introduced in 1855 by Passed Midshipman J. M. Brooke of the U.S. Navy. In Brooke's apparatus spherical weights carried the line to the bottom and were detached when the seabed was reached. A relatively light metal cylinder which collected a small sediment sample could then be brought back to the surface. For the *Cyclops* survey Dayman had had Brooke's device modified (Fig. 3), principally by replacing the spherical weights by elongated conical ones, by using wire slings instead of ropes, and by fitting a valve at the bottom of the cylinder.[10] It was this modified version which was supplied by the *Bulldog*.[19]

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Unfortunately, the hopes placed in Brooke's sounding device were not realised, for although the principle of detaching the weights was a very valuable one which is still used today, the system used to obtain a sample of the sea-bed rarely succeeded in retrieving any significant amount. Since a knowledge of the nature of the bottom was as important to the telegraph company as the actual depth, efforts had to be made to remedy this situation. At an early stage in the voyage, therefore, M'Clintock had a cup-lead made similar to that used previously with considerable success by Dayman. This was simply a conventional deep-sea lead with a conical cup attached beneath it to be forced into the sea-bed and fill up with sediment. The cup-lead worked quite well where the bottom was soft and in moderate depths where it was not necessary to detach the weights. But this still left the problem of obtaining material from greater depths and from regions where the bottom was too firm for the cup lead to penetrate.

To overcome these problems a new sounding device was produced and eventually came to be known as the *Bulldog* clam (Fig. 3). It is not clear where on board the idea for this device originated. Wallich was pretty certain that it was with him, for his diary written on the ship and subsequently published contains this passage.

"I have devised, and submitted to Sir Leopold M'Clintock, a modification of the 'clams' which he described to me as having been employed by Sir John Ross many years Instead of clams I have suggested *cups,* closing on hinged levers, and available with the hollow Brooke's sinkers supplied for use on board the *Bulldog.*"[20]

M'Clintock, on the other hand, relegates Wallich's contribution to third place:–
". . . . the zeal and ingenuity of Mr. Roughton, Chief Engineer, and Mr. Steil, Assistant Engineer, and Dr. Wallich, Naturalist, supplied simple and efficacious means of bringing up them in larger quantity; and not only the superficial layer of impalpable mud, but material from beneath it, generally differing in colour and tenacity, and stones of more than an inch in diameter.

I am chiefly indebted to Mr. Steil, whose double-scoop machine was the first to achieve this great success. . . ."[21]

If Wallich had really felt that he had not been given sufficient credit for his part in the development of the clam it would have been very uncharacteristic of him not to refer to in his manuscript notes. Since there is no sign of such a reference it seems likely that M'Clintock's account is fairly accurate.[22]

M'Clintock commissioned the *Bulldog* at Portsmouth on 2nd June 1860, when she fitting out, and it was not till the 24th that he proceeded out of Spithead. He sailed round the Lizard and up the Irish Sea and past Benbecula, and did not get steam up until 2nd July when he passed Stornoway – whence he made his application to become a Fellow of the Royal Geographical Society.[23] Progress was then rapid, and after sighting Faroes at 2.45 a.m. on the 4th July, M'Clintock anchored in Westmanshavn, where he stayed a day and a half. He took no soundings on this outward passage as the Hydrographer did not attach much importance to them.

The work commenced from Myling head in the Faröes, and on the passage to Iceland and bad weather gave M'Clintock disagreeable and anxious nights.[23] Nevertheless, he able to take 23 soundings (ranging from 61 fathoms on a rise, to 682 fathoms) before sighting Iceland on the afternoon of 10th July. On the following day he made Reykjavik where he found the French frigate *Artemise*, and where he swung his ship for compass deviation.

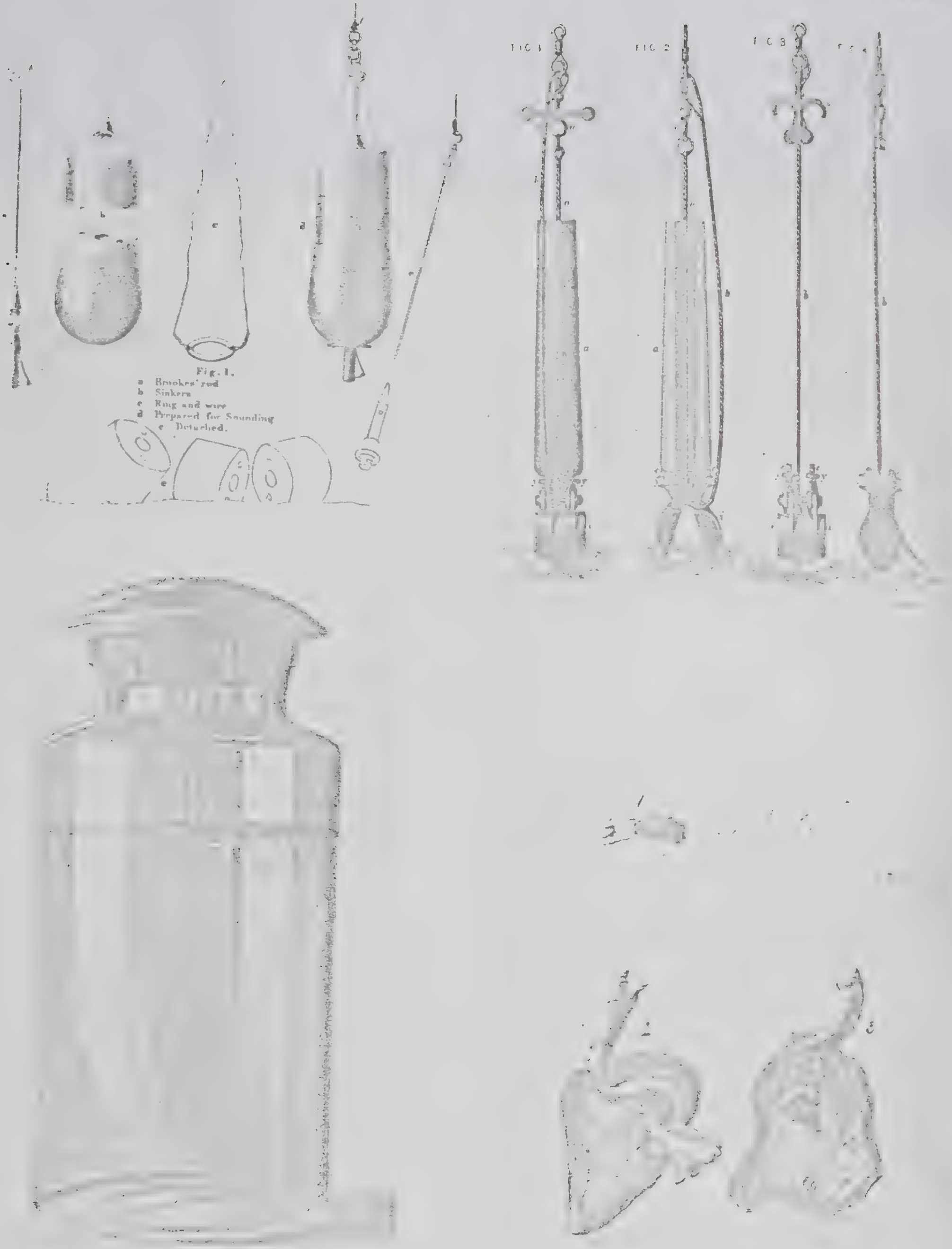


Fig. 3. (Top left). Dayman's modification of Brooke's sounding apparatus, reproduced from Dayman (1858) (see Note 10). (Top right). The *Bulldog* clam, reproduced from M'Clintock (1861) (see Note 19). (Bottom left). Wallich's illustration of a brittle-star attached to a portion of his sounding line, reproduced from *The North Atlantic Sea-Bed* (see Note 20). (Bottom right). Wallich's sketch of worm tubes brought up in the conical cup during the voyage of the *Bulldog* from 682 fathoms. Reproduced by permission of the Trustees of the British Museum (Natural History).

The expected supply of coals had not arrived, and as there was nothing more to detain him M'Clintock weighed anchor on 14th July for the interesting part of the voyage. Having steam power, he was able to make a direct course for the east coast of Greenland.[25] With five days of very fine weather and a sea free of ice, he was able to take regular soundings, twenty-nine in all, reaching 1572 fathoms mid-way between Iceland and Greenland. On the 19th, when he was close to the coast of Greenland, he passed several icebergs and small pieces of drift ice which stayed with him next day and prevented him from approaching close than 45 miles from the coast. He was able to take no soundings, but that was of no great importance to him since the inshore survey was the work of Allen Young in the *Fox* (*see* note 15).

Cape Farewell was rounded on the 21st and M'Clintock made for Godthaab, but for more than a fortnight severe weather and ice kept him running up and down the coast, and it was not until the 7th August that he was able to proceed under easy steam into Godthaab Harbour. During this time he took only one sounding, in 700 fathoms some 60 miles off Frederikshaab. At Godthaab he found a number of vessels including the *Cicerone* which had been sent out to coal the *Bulldog*. One day was given to surveying and this was supplemented by valuable information gathered from a Mr. Kleinschmidt, a Lutheran teacher, surveyor and keen geographer.[27]

To continue his line of soundings, M'Clintock left Godthaab on the 13th, passed south within sight of the west coast of Greenland to the latitude of Cape Farewell, before striking across Davis Strait for Hamilton Inlet. His first sounding when departing from the Greenland coast was 1177 fathoms. He found 2032 fathoms mid-way between Greenland and Labrador, while his last sounding, about 60 miles from Hamilton Inlet, was 1190 fathoms. Once again, steam had allowed him to take a direct course. He ed up Hamilton Inlet on 24th August for 115 miles, surveying as he went, to North West River. Here he met the Hudson's Bay Company factor, Donald Smith (later to become Lord Strathcona) who gave him information about the interior of the country.[28]

M'Clintock stayed in Hamilton Inlet until 31st August when he made for Sydney, Cape ton Island, to coal and rate the chronometers. During the course of August he had 33,000 fathoms of cod line and 3,700 fathoms of deep sea line. The *Bulldog* reached ey on 6th September and M'Clintock reported in the log book that he had to place arpenter under arrest for intoxication and absence without leave. As with the *allenger*, the severity of the service led to numerous desertions at Sydney (a point not ioned in the log book[29] though a few days later he did note that three men were ished for attempting to desert).

The ship spent less than a week at Sydney as it was getting late in the season for se waters, and M'Clintock sailed on the morning of September 12th to return to Harbour at the south of Hamilton Inlet. Here he stayed less than a day, leaving on 17th to cross the mouth of Davis Strait to Greenland once more, this time making Julianshaab where he hoped to receive news of the *Fox* and the results of her inshore eys. During this crossing he was able to corroborate some of the results obtained on ward passage, finding a depth of 2,000 fathoms close to his earlier record of 2,032 oms, and sounding in 1913 fathoms on the following day while still in the entrance he Strait.

n nearing the coast of Greenland, M'Clintock experienced an unusual quantity of e[30] and a force 10 wind. In the approach to Julianshaab, which he reached on

September 29th, he ran the *Bulldog* aground on a ledge with the tide falling. She had list of 10° to starboard before she was floated off about six hours later, having been lightened of part of the provisions and stores.

The hoped for news of the *Fox* was not forthcoming at Julianshaab so that M'Cli still had no clear idea where the cable route would leave the west coast of Greenland. But he was told that Tessermiut Fjord was the most likely site and he sailed on Oct 3rd with the intention of surveying it. But wind and ice prevented this, and, indeed, having got out from Julianshaab, M'Clintock could not approach the coast again closer than about 40 miles. In rounding cape Farewell he had to pass through ice and bergs, and it became evident "that an early and severe winter had set in . . . . so that ice navigation was at an end"[31] and he decided to leave Greenland to survey the direct route to Rockall avoiding Iceland, more or less along the 60th parallel. But he ran into exceptionally bad weather, experiencing gale force winds almost every day. On the 8th and 9th they reached force 10, 11 and 12 – ". . . a perfect hurricane with tremendous seas," and the *Bulldog* had to lie under bare poles. During this period the ship lost h dolphin striker, a 25-foot cutter, oars, capstan bars, angle irons from the paddle boxes and other equipment.

By the 16th M'Clintock had reached 26°W, about half-way between Greenland and Rockall, but he had been able to sound only four times because of the bad weather. Nevertheless, these sounding were quite significant for they ranged from 748 to 1620 fathoms in a region where they had expected at least 2,000 fathoms. The last of the four, in 1260 fathoms, was for Wallich the most important one of the whole voyage, the line came up with starfishes entangled in it (see later). Finally M'Clintock had to interrupt his line of soundings to Rockall and on 17th and 18th October he made for Reykjavik where he spent 10 days making good the storm damage. Leaving Iceland again on the 28th October he resumed the survey to Rockall which was passed on November 8th at a distance of 29 miles.

Continuing adverse winds and a shortage of coal forced M'Clintock to make sail for Ireland where he sheltered in Killybegs Bay on November 11th. The next day Wallich left the ship to return to London overland via Dublin, while M'Clintock remained at Killybegs for four days making repairs. The remainder of the trip was uneventful, Portsmouth being reached on the 19th, where a seaman was given 56 days punishment for attempting to desert; and after five months of this service he could hardly be blamed!

On January 28th, 1861, the results of the *Bulldog* survey, along with those of the *Fox* and of the overland parties, were presented to the Royal Geographical Society at Burlington House and the ensuing discussion was continued at the next meeting on February 11th. All of the reports were optimistic, and although there were some misgivings amongst the commentators about the possible dangers to the cable from icebergs and the problems of very difficult terrain for the overland sections, particularly across Iceland, the reception was in general very enthusiastic.

Ultimately, of course, the problems associated with the Arctic route out-weighed the advantages, but although the *Bulldog* survey was not used for the purpose for which it was intended the results were of considerable significance in the development of marine surveying and oceanography and Wallich enthusiastically publicised them.

Shortly after he arrived back in London he published extracts of his journal kept at sea and containing a preliminary account of the results.[32] Wallich included a short secti

this pamphlet in which he made a plea for more detailed sounding surveys to determine lines of submarine telegraph cables. But his main aim was to present his views, supported by the *Bulldog* voyage results, on the presence of life at great depths in the sea and particularly whether the foraminifera, whose shells formed the bulk of the widespread calcareous deep-sea sediments, lived on the sea-bed or in the surface waters above it.

This same theme formed the subject of a lecture which Wallich delivered to the Royal Institution on January 25th 1861, and was much more exhaustively treated, in typically verbose style, in his best-known publication, *The North-Atlantic Sea-Bed*, which appeared in 1862.[20] Since Wallich's later grumbles were largely based on what he claimed was a failure to give due credit to this last work, it is worthwhile examining it in some detail.

The first 72 pages are devoted to a chronological account of the voyage, the places visited and the sounding results, obviously based mainly on Wallich's diary. Apart from a rather strange section in which he attempts to equate the unexpectedly shallow soundings obtained between Cape Farewell and Rockall, on what is now known as the Reykjanes Ridge, with the "Sunken land of Buss" of the old navigators, this first part is mainly a straight-forward factual account.

On the other hand the second part, subtitled "The bathymetrical limits of animal life in the oceans", is full of conjecture and is a detailed exposition of Wallich's opinions on this subject. As usual, the style is extremely cumbersome, but it is nevertheless a valuable and comprehensive summary of mid-19th century opinions about the fauna of the deep sea and of the facts on which they were based.

Wallich begins by illustrating the widespread acceptance, up to the time of the departure of the *Bulldog*, of the idea that life could not exist under the extraordinary conditions of pressure, light and temperature prevailing in the great depths of the sea. The most reasoned and famous version of this idea was the "azoic theory" of Edward Forbes, based on his dredgings around the British coasts and in the Aegean in the 1830s and 1840s, and according to which little or no life extended much below about 300 fathoms. The most recent version of this theory, in Forbes's posthumously published "The Natural History of the European Seas",[33] had appeared only one year before the *Bulldog* had sailed and Wallich quotes from this book and from several other eminent authors who had fully adopted the "azoic" idea.

"Having thus shown", writes Wallich, "how universally the opinion has been entertained that life is limited to depths which vary slightly in different localities with the downward range of the deep-coral zone, I would now direct attention to the nature of the evidence which has hitherto been adduced in support of an opposite view, by three writers whose names will always be associated with great scientific discoveries in their respective departments, namely, Sir John Ross, Sir James Ross, and Professor Ehrenberg".[34]

But Wallich is now in something of a quandry, for while he agrees with the conclusion of these authors that animals are to be found at very much greater depths than the azoic theory would allow, he is anxious that the credit for providing the absolute proof of this should fall to himself and the *Bulldog* soundings.

John Ross's retrieval, apparently from close to the bottom in 1,000 fathoms or more, of a starfish and a basket star which became entangled in his sounding line at the 800 fathom mark in Baffin's Bay in 1818, is mentioned in some detail. But while Wallich obviously does not condone the fact that these results had been almost entirely ignored

in the intervening period, he casts some doubt on their value, firstly because Ross did not state whether the animals were alive when they reached the surface, and secondly because the echinoderms could not possibly "have been found free-floating and alive at a distance of 200 fathoms from the bottom" as indicated by their position on the sounding line. It does not seem to have occurred to Wallich that the sounding itself could have been erroneous and that the line might have piled itself on the bottom and thence picked up the starfishes.[35]

Turning to James Clark Ross's dredging results from the *Erebus* and *Terror* between 1839 and 1843, Wallich acknowledges that crustaceans were brought up from 400 fathoms but this was not much deeper than the limit of life according to the azoic theory and therefore contributed little to the argument.[36]

Finally Wallich deals with Ehrenberg. The German Professor had been convinced that Foraminifera and Radiolaria which he had examined from sea-bed samples brought back by James Clark Ross had reached the surface alive because they retained traces of protoplasm, or sarcode, in some cases through several years of storage in closed bottles. Wallich maintains that "the presence of the sarcode . . . proves nothing beyond the powerful preservative effects of sea-water, surcharged, under a stupendous pressure, with its saline constituents." So that although Ehrenberg was quite right in believing in the existence of life at great depths, Wallich said that his observations did not justify this conclusion!

The field was now clear for him to deliver the *coup de grace* to the azoic theory with what he thought was the ultimate proof–the results of the *Bulldog* soundings. But he is not quite ready to produce this master blow; first he has to dispose of the arguments advanced against the existence of an abyssal fauna which were based on the inhospitable physical conditions obtaining in the depths of the sea.

The idea that animals could not survive in the intense cold of the ocean depths is dismissed with a very clear exposition of the widely held, but erroneous, "4°C theory". This theory was based on the misconception that sea-water, like fresh-water, attains its maximum density at 4°C or about 39.5°F. Water at this temperature would therefore fill the great ocean basins, being overlaid by warmer layers in the tropics and by cooler layers near the poles, while at an intermediate latitude, at 56° 62′ according to Wallich, the sea had a uniform temperature of 39.5°F from top to bottom. There was therefore no temperature barrier to the existence of a deep sea fauna.

The 4° theory was finally dispelled by the *Lightning* and *Porcupine* cruises in 1868–70. When Wyville Thomson wrote up the results of these cruises in 1873 he quite rightly pointed out Wallich's adherence to the old idea, at the same time admitting that both he and Carpenter had been similarly mistaken until this time.[37] But Wallich seemed quite incapable of admitting a straightforward error, and in his marginal notes on his personal copy of the published version of his 1861 lecture to the Royal Institution, referred to above, he even tried to wriggle out of this one, writing that it "clearly shows that I did not apply the 39° doctrine in the strict sense in which others used it".[38] He could write this only in the short abstract of his views which he was able to give in a single lecture, for the more explicit version in the *North Atlantic Sea-Bed* equally *clearly shows* that he was a strict adherent of the theory.

Wallich now deals with the "false analogies . . . . advanced to show what would be the effect of the stupendous pressure known to prevail at the bottom of the ocean on creatures constituted to exist under a totally different series of conditions. Thus, the

.f the air bladder in some fishes, the disembowelment of others, ... the d experiments on submerged logs of wood and legs of mutton . . . . have one ·en more or less emphatically dwelt on and handed down from writer to writer, , a troubled dream which the mind finds difficult to shake off, a fictitious belief alogy of the cases was engendered." Although his arguments are full of irrel- nd are therefore somewhat difficult to follow, he eventually points out, quite , that where a state of equilibrium exists, that is when the internal and external are equal, no damage need be caused no matter what the pressure. Even .n pressure can be adapted to if they are not too rapid and particularly where "no gaseous contents present, and the circulating fluid is of the same or very ie same specific gravity as the surrounding medium, and every portion of the is completely pervious to fluids, either by its porosity or through endosmotic . ."

y, Wallich discusses the significance of light in the bathymetrical distribution of He acknowledges the undoubted reliance of plants on sufficient light for thesis, but argues against the corollary that since animals are ultimately it upon plants for nutrition, they too are restricted to the light zones. He is provide a convincing answer to the question "How . . . . can marine animal aintained without the previous manifestation of vegetable life, as must be the exists at extreme depths?" For he did not appreciate the principle of primary ity in the open ocean taking place in the near-surface euphotic zone, with the this productivity moving down to the lower layers. Instead, he resorts to a lame argument for a system of organic synthesis in the protozoa different from 'n in plants and independent of light. "The humble Rhizopod or Polycystine t, secrete, excrete and (for all we can adduce to the contrary) think into the At any rate he dismisses the total darkness of the abyss as a reason for the f animal life – and in this, of course, he was correct!

. now describes the *Bulldog* soundings in some detail, for he was convinced proved byond doubt the existence of complex life-forms in the ocean depths 'urnished the clearest evidence to date that the foraminifera lived on the nd not in the surface waters.

ıefore the *Bulldog* cruise he seems to have been convinced that the 'azoic' view orrect, and as early as July 8th 1860, during the passage from the Faröes to he conical cup brought up from 682 fathoms a calcareous tube of a Serpulid .e worm and "a minute *Spirorbis* and two shells of *Truncatulina lobata* still to small stones and apparently alive" (Fig. 3). But this paled into insignificance : result of a later sounding, one of the unexpectedly shallow ones made during ›art of the very rought passage from Greenland towards Rockall.

sounding far exceeds in importance any previous sounding on record; for not it for ever determine the fact that animal existence may be maintained at stly greater than by most persons has been believed possible, but it proves the several of the conditions which have heretofore been supposed to limit the ical distribution of animal life, and points to the existence of a new series of ›eopling the deeper abysses of the ocean, and destined, perhaps, to furnish many sing links between the submarine faunas of the Past and Present. That single I may be permitted to say, compensates for every disappointment that weather

and accident may previously have engendered. At the eleventh hour, and under circumstances the most unfavourable for searching out its secrets, the deep has sent forth the long coveted message. What mechanical ingenuity failed to achieve, hunger or curiosity accomplished; and thus whilst the sounding apparatus only succeeded in bringing up from a depth of 1260 fathoms a number of minute shell-covered creatures, so simply organised as to render them incapable of perceiving or escaping a danger, thirteen star-fishes, ranging in diameter from 2 to 5 inches, came up convulsively embracing a portion of the sounding line which had been paid out in excess of the already ascertained depth and rested for a sufficient period at the bottom to permit of their attaching themselves to it [*see* Fig. 3]. These star-fishes arrived at the surface in a living condition, and, what is still more extraordinary, continued to move their long spine-covered rays for a quarter of an hour afterwards – clearly proving that, if their adherence to the sounding-line was due, in the earlier stage of their progress upwards, to a clonic spasm of the muscular tissue, neither life nor nervous energy ceased till after the lapse of the period mentioned."[34]

This quotation is from the first part, or diary of the *North-Atlantic Sea-Bed,* and is accompanied, as mentioned above, by Wallich's arguments that the region in which this and the previous sounding were taken was associated with the "Sunken land of Buss". In the detailed consideration of the "Star-fish" sounding in the second part of the book he returns to this same theme and concludes that there is "very little room for doubt that a vast area of the sea-bed, involving the whole of these positions, has shared in the submergence".

This supposed submergence was to be of great significance later in his argument, but first he had to remove, to his own satisfaction, any possible doubt that the star-fishes came from the bottom and at the depth stated.

The depth, suggests Wallich, was beyond question, for it was determined on three separate occasions, all with the same result. As mentioned earlier, it was the practice on the *Bulldog* to carry out each sounding operation twice, the first time simply to determine the depth by means of the deep sea lead, and the second time to obtain a bottom sample. On this particular occasion this second operation was initially attempted with the newly developed *Bulldog* clam, though Wallich refers to it as a "deep-sea dredge". But the clam failed to bring up an adequate sample and the sounding was therefore repeated with the conical cup, "50 fathoms of line in excess of the recorded depth being paid out in order to ensure the unchecked desent and impact of the instrument at the bottom." It was to this first 50 fathoms above the lead that the star fishes were attached, providing strong evidence that the animals came from the bottom.

But there was other evidence too. Wallich quotes several authorities, including Edward Forbes himself, confirming that the ophiuroids, to which his captured specimens belonged, are adapted for life on the bottom and not in midwater. The possibility that they could have been carried by a current from the nearest shallow water some 250 miles away and all alighted on one 50 fathom section of the line "moving through the water at a mean speed of at least sixty yards per minute" is also considered unlikely in the extreme.

To these pieces of evidence Wallich adds the facts that he found fresh looking foraminiferans in the guts of the star-fishes, and that in the deep soundings he also found tubes, presumed to be those of annelids, made of *Globigerina* shells, sponge spicules and diatom frustules in the same proportions as these elements were found in the samples of the

rom the same localities. He concludes "that the presence of a living fauna in abysses of the ocean has been fully established".

is by far the most important conclusion in the *North-Atlantic Sea-Bed* and, as e, was not immediately accepted by the rest of the scientific community, but oceeds to cloud the issue somewhat with his anxiety to explain where the deep- originated. He identified the brittle stars as *Ophiocoma granulata* (= *Ophiocomina* ldgaard)), a well-known shallow water species restricted to depths less than about 0 fathoms), and concluded that they had become gradually acclimatized to the ; of the deep sea during the slow subsidence which he similarly considered to be

de later Wyville Thomson pointed out that "The misfortune of these star- that they did not go into the dredge; had they done so, they would at once ved immortality. *Now*, of course, we have no doubt that they came from the ut their irregular mode of appearance left, in the condition of knowledge and at the time, a loophole for scepticism."[40]

pite Wallich's detailed arguments to the contrary, there was still the possibility, ugh it might be, that the animals had been picked up by the line during its lherents of the azoic theory refused to be shaken in their convictions by such vidence, and it was not until the cruises of the *Porcupine* in 1869, when a nimals were brought up in the dredge from depths down to 2,435 fathoms, a was finally abandoned.

he 1860s more and more evidence was accumulating against the azoic theory ety of sources. One of the most convincing was the retrieval, by the engineer nkin, of corals attached to a portion of the submarine telegraph cable between Bona at a point where it had undoubtedly been on the bed of the Mediterranean of 1200 fathoms ever since it was laid in 1857. Fleeming Jenkin had raised the autumn of 1860, at more or less the same time that Wallich was retriev- ishes from the North Atlantic. But although Wyville Thomson later came to as the "first absolute proof of the existence of highly-organised animals living f upwards of 1,000 fathoms,"[41] there was undoubtedly a strong bias amongst favour of results obtained with the dredge and a reluctance to accept om any other source. This was clearly stated in the passage from the *Depths* quoted above, and was the reason that much more importance was attached ging results of Prof. Michael Sars down to 450 fathoms off the coast of Count L.F. de Pourtales to 517 fathoms off the coast of Florida and of Prof. ght in 480 fathoms off Portugal, than to Wallich's work in much deeper water.

'8; A PERIOD OF PUBLIC PROTEST

upation with the dredge obviously irked Wallich very greatly and became one bones of contention with Carpenter and Wyville Thomson, but his first public t was a letter published in the *Annals and Magazine of Natural History* in 368 in response to Percival Wright's account of his results which had appeared ournal in the previous issue. In this paper Wright had referred to Wallich's the starfishes as 'accidental', a description which was obviously prompted by e of Wallich's identification of them as the shallow water species and his

inability to believe that such a species could occupy such a tremendous bathymetric range. But Wallich took particular exception to this reference. "Scientific men", he wrote, "are quite competent to decide whether a discovery made with a "*sounding-line*" (for which Dr. Wright expresses such contempt) is a discovery of less value than one made with a "dredge", and further, whether the mere circumstance of a set of Echinoderms showing a preference for a piece of sounding-line, when they might have secured an easy passage of a mile and a half within a comfortable copper or iron receptacle, can detract in the slightest degree from the value or significance of the discovery *when worked out to its legitimate conclusion*."

But it was the reports of the *Lightning* and the *Porcupine* cruises in 1868 and 1869 which really upset Wallich and gave him his very low opinion of Carpenter and Wyville Thomson.[42]

His criticisms were concerned with two main points, firstly the failure to recognise his capture of the brittle stars on the sounding line as absolute proof of the existence of life deeper than 1000 fathoms, and secondly what he considered to be plagiarism of his observations and views on the origin of the widespread forminiferan oozes on the deep ocean floor. The second problem had taxed marine scientists since the 1840s and 1850s when both J. W. Bailey and Christian Ehrenberg had examined deep sediment samples from the Atlantic and had come to diametrically opposed conclusions. Bailey thought (correctly) that the shells making up the sediments had been derived largely from organisms which had lived in the surface layers and had fallen to the bottom only after death, while Ehrenberg believed that they had spent their lives on the sea-bed itself.

Subsequent authors tended to align themselves with one or other of these views. Huxley, for instance, in his report on the sea bed samples collected by Dayman in the *Cyclops*, while being very cautious on this point, favoured the Ehrenberg view, stating that "the balance of probabilities seems to me to incline in that direction".[43] Wallich, as we have seen, was convinced that this was correct, but during the mid 1860s Samuel Owen published new evidence from tow nettings supporting Bailey.[44] The controversy was therefore very much alive when Carpenter and Wyville Thomson embarked on their series of cruises in the *Lightning* and *Porcupine*.

In the various official reports of the results of these cruises and in the semi-popular account in *The Depths of the Sea,*[37] both Carpenter and Wyville Thomson came down strongly in favour of Wallich, although the malacologist Gwyn Jeffreys, who took part in the *Porcupine* cruises of 1869, favoured the contrary view. However, by 1874 Wyville Thomson had completely switched sides, largely as a result of John Murray's townettings from the *Challenger* in which foraminiferans identical with those on the sea-bed deposits had been taken at the surface.[45] Carpenter, while still clinging to the idea that the adults lived on the sea-bed, attempted to reconcile this with the new evidence by suggesting that the *Globigerina* spent their young stages in mid-water and sank to the bottom for the later part of their lives.[46]

But while Wallich made great play of these various changes of heart, it was not so much the opinions of Carpenter and Wyville Thomson that bothered him, but rather the way in which he was treated at their hands. In 1876 he published privately *The Biology of Globigerina* in which he "endeavoured . . . to weigh the whole of the evidence, heretofore published, which bears on the life-history and relations of the GLOBIGERINAE". In this hard-hitting tract Wallich criticises a number of authors, including Huxley and

ffreys, though he concentrates on Carpenter and Wyville Thomson. By extensive ns from his own and their papers he attempted to show that they "merely my observations whilst attempting to make it appear that my inference was rted by sufficient evidence until their Dredge furnished it".[47]

comparing the writings of Carpenter and Wyville Thomson on the subject in the 0s and early 1870s with his own a decade before, he complains "I cannot consent thod of placing these facts on record (adopted by Dr. Carpenter on the one hand, Dr. Thomson on the other), which is so palpably calculated to deprive me of what-dit may attach to having gathered together this mass of evidence in the face of rious difficulties and discouragements. No one who reads the above extracts y, can fail to recognise the identity of the facts, the reasonings, and the conclusions re adduced in the passages cited. To say the least of it, such a coincidence of xtending not unfrequently to coincidence in the very expressions made use of in ng them, is in the highest degree remarkable."[48]

aking these suggestions, bordering on an accusation of plagiarism, Wallich had stification, for both Carpenter and Wyville Thomson had a habit of treating him at patronisingly, warmly agreeing with his conclusions but saying that the e on which he based them was not sufficiently good to prove his case – much e approach as that used by Wallich towards Ehrenberg. They would then go on that their own results confirmed his views, though their new evidence was often convincing than Wallich's had been.

of Carpenter's and Wyville Thomson's publications appeared in the Proceedings Royal Society of London from which, since he was not a Fellow, Wallich was d. He was convinced that this alone lent to the works of his opponents a credence yes of the scientific community at large which they did not deserve, and in the to the *Biology of Globigerina* he voiced these misgivings.

quoting freely both from my own previous writings on the subject, and the of other Observers who, like myself, have taken a practical part in Deep-sea tion, it has been my aim to avoid the risks of misinterpretation always more or eparable from epitomized opinions. The expediency of this course will, I venture ve, become manifest when it is seen how frequently, during recent years, erroneous ntradictory statements regarding some of the most important problems connected eep-sea research, have been submitted to the Public with all the prestige attaching ication in the Journal of the first Scientific Society in the Kingdom".

ng made his position clear, Wallich waited for some satisfaction. But when, late 7. Wyville Thomson's two volume work on the results of the Challenger Expedition Atlantic appeared,[2] with no retraction or word of praise in its pages, he appealed Royal Society itself.[49]

arly December he wrote to the President and Council of the Royal Society charging ter and Wyville Thomson with "deliberate misstatements, plagiarisms, and errors . . . d over again promulgated in the Proceedings of the Royal Society". By private ondence, the President, Joseph Hooker, tried to dissuade him from bringing as the Society's only power of redress lay in expulsion of members for "Evidence ed in the Society's Proceedings or Transactions that something has been done to age, detriment or dishonour of the Society". Though Wallich appears only to shed for some sort of public recognition for his claim, a claim too complex for

the charges to be stated succinctly in his correspondence, he persisted with his demand for official action. His formal request had therefore to be dealt with.

In a joint letter the Society's two secretaries, G. G. Stokes and T. H. Huxley, pointed out to Wallich that the President and Council had no authority over the behaviour of Fellows or their role in scientific disputes. Since the only action which could be taken was expulsion, Wallich must prefer specific charges and make out a *prima facie* case before the matter could be put before the Council. Wallich demurred, since he refused to have any body other than the Council decide whether he had made a *prima facie* case. And in any case, he continued, "The sole redress I have asked for is that which would be furnished by an authoritative expression of opinion on the part of the President and Council that the injustice of which I have reason to complain has been inflicted on me by the Fellows concerned". That is, he wanted what the Society's officers could not give him: public recognition that he was right. Stokes and Huxley replied that they stood on their previous request for documented charges.

These three exchanges of letters occupied the first two weeks of December 1877. Wallich, who had been so eager to begin the affair and to keep up the pressure, now brooded for two weeks before writing again to Hooker, shifting the focus of his attack to Huxley.

In his original letter charging Carpenter and Wyville Thomson with conduct improper for scientific men, he had requested that none of the arbitrators to whom he wished to present charges at "a formal and public" hearing "shall have taken part in, or published opinions on topics relating to, Deep-sea Exploration", since nothing technical would be involved. Now he used this obsession with conspiracy to claim that Huxley, with whose opinions on *Bathybius* he had earlier disagreed, could not be impartial in deciding whether or not a case against Carpenter and Wyville Thomson could be made. Huxley was outraged; "Dr. Wallich says we (the Secretaries of the Royal Society) are not to perform the duty of satisfying ourselves that his charges against two Fellows of the Royal Society are not merely frivolous and vexatious, because forsooth, somewhere or other he has criticised the work of one of us". Hooker forwarded Huxley's response to Wallich.

In his reply Wallich, still on the trail of the red herring of Huxley's impartiality, came to the heart of the matter. Huxley claimed not to have read Wallich's writings on the *Bathybius* controversy. Wallich accepted this claim, but he then produced receipts, signed by Huxley as Secretary, for the copies of his papers which he had sent to the Royal Society and lamented the failure of his efforts to get his results into the eye of those whose judgement counted. This was the source of many of his grievances against Carpenter and Wyville Thomson: "where a series of elaborate papers relating to deep sea research . . . have been almost entirely ignored by two writers who have set forth most of my facts, my conclusions, and the detailed proofs on which these conclusions were based, as new and original; their descriptions being in certain instances couched in terms so nearly identical with those employed by me, as to render it in the last degree improbable that the coincidence could be altogether accidental; I respectfully submit that the legitimate limits of scientific discussion have been widely transgressed, and the culpability of the procedure materially aggravated, through its having been carried out to its ultimate consequences, under the *imprimatur* of the Royal Society . . . . so long as the laboriously worked out discoveries of men who have taken an active part as pioneers in

any special department of research can thus flagrantly be ignored, simply because embodied in less powerful and less widely distributed Journals than 'The Proceedings . . . . . .', a fatal blow must necessarily be struck at that freedom of discussion which is both the safeguard and the source of Scientific accuracy."

How could one reply to a man whose grievance was that no one had recognized his priority, who in the name of science demanded of the Royal Society a superhuman perfection in the distribution of the rewards of recognition and membership? Huxley offered to withdraw from the matter, and Hooker told Wallich to get on with preparing his charges. Any sympathy they could have felt for a man whose rewards may have been small in relation to his achievements would have vanished long ago as their own struggles for recognition had reached fruition. Hooker and Huxley were too harassed by their responsibilities for the present and future of British science to take seriously the problems of one who had failed to make, as they had, the transformation from surgeon naturalist to man of science. Though he promised in the middle of January to draw up his charges, Wallich seems never to have done so.

4. 1878–1898: OLD AGE, UNRELIEVED FRUSTRATION AND INTENSE PRIVATE CRITICISM

Wallich was now 62 years old and his best scientific work was behind him, although in the next ten years he published a few papers, mainly on protozoan classification and the role of lower organisms in the formation of geological deposits. These papers had the usual Wallich content of criticism of other authors for not recognising the importance of his own work, but in public, at least, he seems to have dropped his antagonism towards Carpenter and Wyville Thomson. In any case, within a few years both his old enemies had died, Wyville Thomson in 1882 and Carpenter in 1885, so that his irritation at them should have been rather less acute.

Nevertheless, he continued to document their 'transgressions', apparently going back over his personal reprint collection time after time to annotate them with more criticisms or malevolent decorations (Figs. 4 and 5). Such a prolific annotator would undoubtedly have filled many a notebook with his observations and opinions and, indeed, one of his manuscripts refers to notebook number 60.[1] Although only a few of these seem to have survived, mainly written after about 1880, the pathetic rantings which they contain provide a clear impression of an increasingly bitter old man. The contents cover a wide range of oceanographic topics and are often confused and disjointed, but they frequently return to a small number of main themes.

Thirty-five years after his cruise in the *Bulldog,* for instance, Wallich was still anxious to establish his claim to the recognition of which he felt he had been robbed by Carpenter and Wyville Thomson.

"*Dredge v. sounding machine*
The conspirators, Fur and Weevil [*see* legend to Fig. 4], throughout their Reports etc. were never tired of pointing out that the latter machine was comparatively useless as a means of scientific research, whereas *Our Dredge* – to quote their own words, furnished irrefutable positive proof that everything brought up in it must have come from the bottom only. Their *Dredge* at *650 faths,* they said, had brought up an *Astropecten* in their first cruise on board Porcupine and *it* also brought up *Bathybius* and thus confirmed

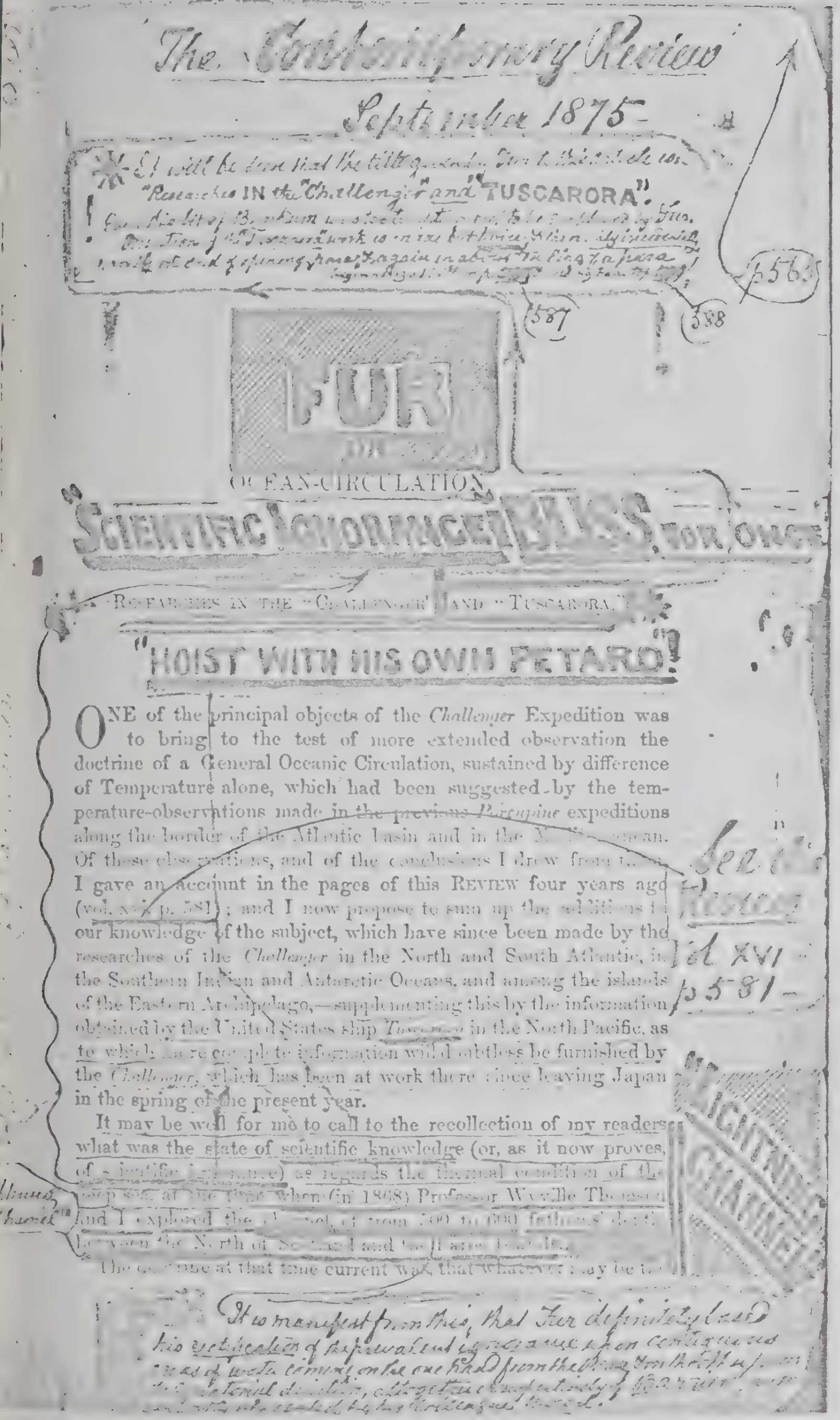
their master Huxley's grand discovery etc. etc. etc. their object being to make it appear that they had been the first to apply the Dredge at really *great depths* this remark being applied by them to the *extreme* depth they had recorded (650 faths) in the first cruise of Porcupine.

Now note the actual facts. In June 1860 when I was appointed by the Admiralty to "Bulldog", I asked the Hydrographer to get a dredge from the Dockyards for me. He said there were none at the Dockyards. In these circumstances and as only a few days remained before the Bulldog was to start, I went to every shop in London in which th [was] any likelihood of getting such an article, but could find none. I then wrote to Damon at Weymouth who wrote to say that he had but [1] and that one he would at once despatch to me; and that there was [no] time to have more made. I got it at a cost of £2-10-0. But I was not allowed to use it in deep water and had only been supp with 200 faths of *deepsea sounding line* from the Bulldog store. I had used it in the Fjord at Goodharb. But whilst a sounding was going on about 20 miles off the west coast of Greenland I put it overboard at the stern of the ship on the chance of bringing up something and having no-one to assist me allowed it to get jammed on a rock at the bottom with all my line out and I found it impossible to clear it. The Bulldog was immediately afterwards underway and the line, being fast to its belaying pin, broke and about half of it hauled in, of course minus my Dredge. As near a copy of the Dredge was then made for me by the Chief Engineer on board, but it was also lost the first time I put it overboard.

I mention this only with a view to prove that I was quite as fully alive to the value of a proper dredge in 1860 as Messrs Fur and Weevil were in 1868, who had had every piece of apparatus including a trawling dredge found for them at the Govt. Expense. I on the other hand, had to purchase *everything* – even to my messing – out of my own pocket – and yet these two dastardly hounds tried – and successfully tried – to cast unmerited discredit on all my discoveries, whilst they pirated them".[50]

By the 1880s so much evidence had been amassed by the *Challenger* and other expeditions about the origin of the shells forming the deep-sea oozes that it could no longer be doubted that most of the organisms had lived in the surface waters and had sunk to the bottom only after death. This meant, of course, that Wallich, along with Huxley, Carpenter and, at least in the early days, Wyville Thomson, had all been wrong to favour the opposite view. Wallich therefore hardly touches this subject,[51] but he does devote considerable space to another problem which originated in the examination of deep-sea sediments – "the Coccosphere Question".

This had begun in 1857 when Huxley had examined the sea-bed samples collected during the *Cyclops* cruise and found small, circular calcareous plates rather like collar studs, which he called coccoliths. When he re-examined these samples some ten years later and made his famous blunder by announcing to the world the discovery of the strange primitive life-form *Bathybius*, he found these same coccoliths embedded in the mysterious gelatinous "protoplasm" and thought they were an integral part of it.[52] He also found the coccoliths aggregated on the surface of membranous balls which Wallich had reported in 1861 and named "coccospheres", correctly deducing that they were independent organisms with no connection with *Bathybius*.[53] But this was not generally accepted until the *Challenger* townet samples proved that, like *Globigerina,* they were derived from the surface waters. In the meantime the significance of Wallich's observations



The Contemporary Review

September 1875

* It will be seen that the title [illegible] "Researches IN the "Challenger" and "TUSCARORA". [illegible]

p 565

587

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FUR

ON

OCEAN-CIRCULATION.

"SCIENTIFIC IGNORANCE [illegible], FOR ONCE

RESEARCHES IN THE "CHALLENGER" AND "TUSCARORA."

"HOIST WITH HIS OWN PETARD!"

ONE of the principal objects of the *Challenger* Expedition was to bring to the test of more extended observation the doctrine of a General Oceanic Circulation, sustained by difference of Temperature alone, which had been suggested by the temperature-observations made ~~in the previous *Porcupine*~~ expeditions along the border of the Atlantic basin and in the M[illegible]ean. Of these observations, and of the conclusions I drew from them, I gave an account in the pages of this REVIEW four years ago (vol. xvi. p. 581); and I now propose to sum up the additions to our knowledge of the subject, which have since been made by the researches of the *Challenger* in the North and South Atlantic, in the Southern Indian and Antarctic Oceans, and among the islands of the Eastern Archipelago,—supplementing this by the information obtained by the United States ship *Tuscarora* in the North Pacific, as to which more complete information will doubtless be furnished by the *Challenger*, which has been at work there since leaving Japan in the spring of the present year.

It may be well for me to call to the recollection of my readers what was the state of scientific knowledge (or, as it now proves, of scientific ignorance) as regards the thermal condition of the deep sea at the time when (in 1868) Professor Wyville Thomson and I explored the channel, of from 500 to 600 fathoms' depth, between the North of Scotland and the Faroe Islands.

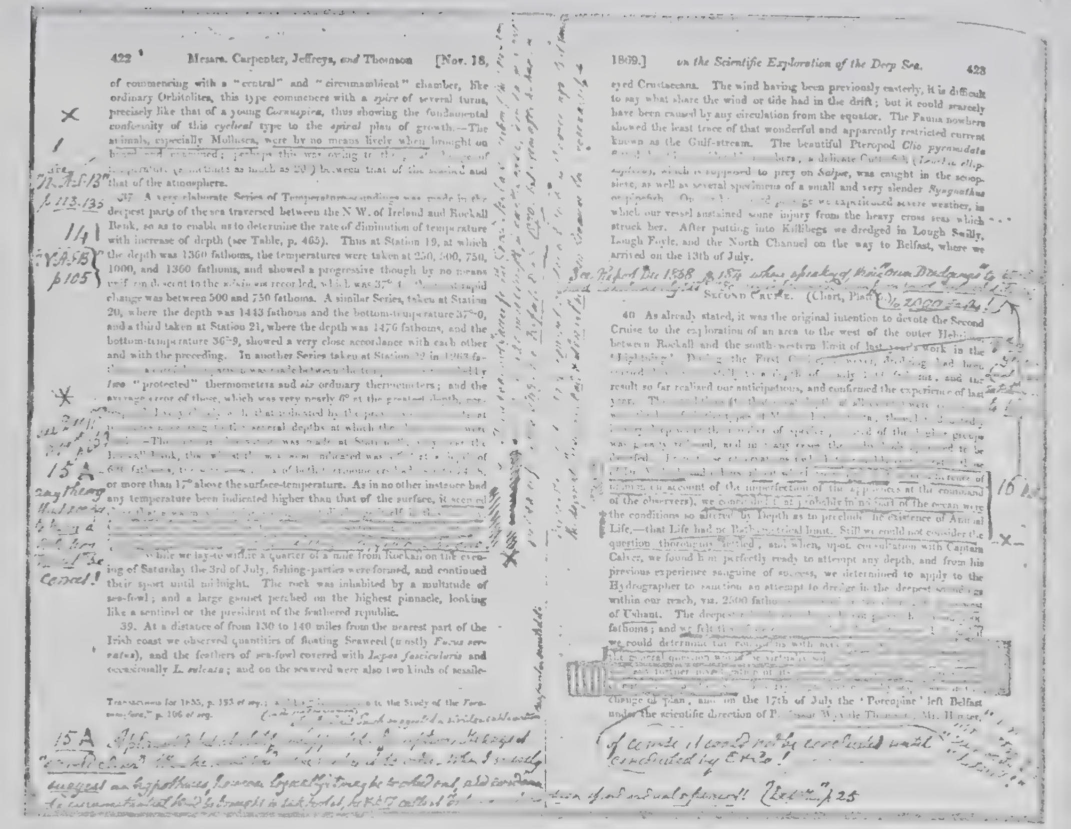
The doctrine at that time current was, that whatever may be the [illegible]

See [illegible] vol XVI p 581 –

[illegible] Channel"

It is manifest from this, that Fur definitely [illegible] his [illegible] of the prevalent ignorance upon [illegible] of water coming on the one hand from the [illegible] [illegible]

. 4. The first page of Wallich's much annotated copy of a paper by W. B. Carpenter on
ean Circulation which appeared in *The Contemporary Review* for 1875. In his personal
es Wallich almost invariably referred to Carpenter and Wyville Thomson as "Fur and
evil"; "Weevil" was undoubtedly a play on Wyville, but "Fur" seems to have been used
tly as an allusion to Carpenter's F.R.S. and partly as the Latin for villain or thief!



422 Messrs. Carpenter, Jeffreys, and Thomson [Nov. 18,

of commencing with a "central" and "circumambient" chamber, like ordinary Orbitolites, this type commences with a *spire* of several turns, precisely like that of a young *Cornuspira*, thus showing the fundamental conformity of this *cyclical* type to the *spiral* plan of growth.—The animals, especially Mollusca, were by no means lively when brought on board and examined; perhaps this was owing to the [illegible] of temperature (sometimes as much as 20°) between that of the seabed and that of the atmosphere.

37. A very elaborate Series of Temperature-soundings was made in the deepest parts of the sea traversed between the N.W. of Ireland and Rockall Bank, so as to enable us to determine the rate of diminution of temperature with increase of depth (see Table, p. 465). Thus at Station 19, at which the depth was 1360 fathoms, the temperatures were taken at 250, 500, 750, 1000, and 1360 fathoms, and showed a progressive though by no means uniform descent to the minimum recorded, which was 37°·4 [illegible] rapid change was between 500 and 750 fathoms. A similar Series, taken at Station 20, where the depth was 1443 fathoms and the bottom-temperature 37°·0, and a third taken at Station 21, where the depth was 1476 fathoms, and the bottom-temperature 36°·9, showed a very close accordance with each other and with the preceding. In another Series taken at Station 22 in 1263 fathoms [illegible] was made between the [illegible] by *two* "protected" thermometers and *six* ordinary thermometers; and the average error of these, which was very nearly 6° at the greatest depth, [illegible] indicated by the [illegible] several depths at which the [illegible] were [illegible].—The [illegible] was made at Station [illegible] Rockall Bank, the [illegible] was [illegible] of 6[illegible] fathoms, [illegible] or more than 17° above the surface-temperature. As in no other instance had any temperature been indicated higher than that of the surface, it seemed [illegible]

[illegible] while we lay-to within a quarter of a mile from Rockall on the evening of Saturday the 3rd of July, fishing-parties were formed, and continued their sport until midnight. The rock was inhabited by a multitude of sea-fowl; and a large gannet perched on the highest pinnacle, looking like a sentinel or the president of the feathered republic.

39. At a distance of from 130 to 140 miles from the nearest part of the Irish coast we observed quantities of floating Seaweed (mostly *Fucus serratus*), and the feathers of sea-fowl covered with *Lepas fascicularis* and occasionally *L. sulcata*; and on the seaweed were also two kinds of sessile-

Transactions for 1855, p. 153 *et seq.*; [illegible] to the Study of the Foraminifera," p. 106 *et seq.*

×

1

see

"N.A.S.13"

p 113.135

14

"V.A.S.B"

p 105

15 A

anything

Convert!

15 A

suggest an hypothesis

[illegible] 25

1869.] *on the Scientific Exploration of the Deep Sea.* 423

eyed Crustaceans. The wind having been previously easterly, it is difficult to say what share the wind or tide had in the drift; but it could scarcely have been caused by any circulation from the equator. The Fauna nowhere showed the least trace of that wonderful and apparently restricted current known as the Gulf-stream. The beautiful Pteropod *Clio pyramidata* [illegible], a delicate [illegible] (*[illegible] ellipsoides*), which is supposed to prey on *Salpæ*, was caught in the scoop-sieve, as well as several specimens of a small and very slender *Syngnathus* or pipefish. On [illegible] passage we experienced severe weather, in which our vessel sustained some injury from the heavy cross seas which struck her. After putting into Killibegs we dredged in Lough Swilly, Lough Foyle, and the North Channel on the way to Belfast, where we arrived on the 13th of July.

See Report [illegible] 1858 p 184 where speaking of their own Dredgings

SECOND CRUISE. (Chart, Plate [illegible].)

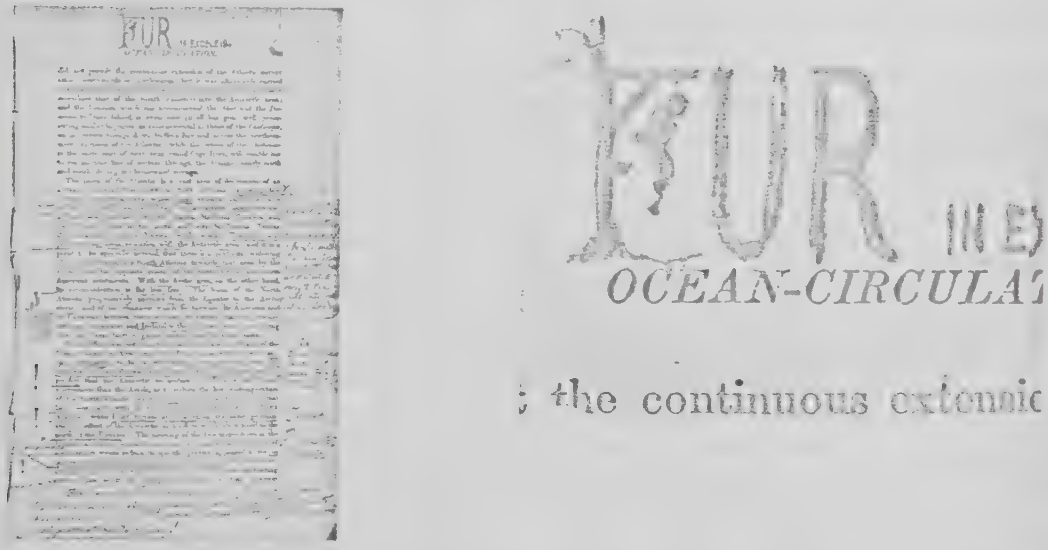
2000

40. As already stated, it was the original intention to devote the Second Cruise to the exploration of an area to the west of the outer Hebrides, between Rockall and the south-western limit of last year's work in the 'Lightning.' During the First Cruise [illegible] dredging had been carried [illegible] to a depth of [illegible] fathoms, and the result so far realized our anticipations, and confirmed the experience of last year. [illegible] account of the imperfection of the appliances at the command of the observers), we considered it probable in no part of the ocean were the conditions so altered by Depth as to preclude the existence of Animal Life,—that Life had no Bathymetrical limit. Still we could not consider the question thoroughly settled, and when, upon consultation with Captain Calver, we found him perfectly ready to attempt any depth, and from his previous experience sanguine of success, we determined to apply to the Hydrographer to sanction an attempt to dredge in the deepest soundings within our reach, viz. 2500 fathoms [illegible] of Ushant. The deepest [illegible] fathoms; and we felt [illegible] we could determine [illegible] [illegible] change of plan, and on the 17th of July the 'Porcupine' left Belfast under the scientific direction of Professor Wyville Thomson, Mr. Hunter,

16 A

×

of course it could not be concluded until conducted by [illegible]!



FUR

OCEAN-CIRCULA

; the continuous extensio

Fig. 5. Top. Part of Wallich's copy of the account by Carpenter, Jeffreys and Thomson of the results of the 1869 cruise of the *Porcupine* which appeared in *Proc. R. Soc.* 18: 397–492 (1869). Bottom. Further embellishments by Wallich of Carpenter's "Ocean Circulation" paper, with Carpenter (presumably) hanging from the gibbet formed by his nick-name. This illustration, and Fig. 4, are reproduced by permission of the Trustees of the British Museum (Natural History).

were not appreciated and even where coccospheres were referred to, his role in their discovery tended to be under-rated or even ignored.

Wallich became particularly incensed by the priority in the coccolith work which Wyville Thomson seemed to credit the geologist H.C. Sorby. For following Wallich's description of the coccospheres in 1861, Sorby had published a paper in which he described how the shape of the coccoliths he had found in chalk deposits some ten years earlier had led him to the conclusion that they were not organic, as was widely held at the time, but had been derived from some sort of spherical organism, just like Wallich's coccospheres. But it was not until he had examined some of Huxley's Atlantic mud from the *Cyclops* that he obtained confirmation of this belief. This, he says, was in August 1860, and on 2nd October that year he read a paper on the subject at the Sheffield Literary and Philosophical Society in which he showed that "the so-called crystalloids of the chalk are not of crystalline or concretionary origin, but are similar to ovoid bodies forming part of the spherical cells in some Foraminifera."[54]

Wyville Thomson referred to this "paper" in a footnote in his *Depths of the Sea* and assumed that it had been published in the Proceedings of the Society.[55] Such a published paper would, indeed, have predated Wallich's own account of the coccospheres, but in fact it never was published. Years later, in 1887, Wallich was anxious to establish this point and wrote to a friend in Leeds[56] to ask him to check it. The enquiry eventually reached Sorby himself, who replied "I may have given some account of what I was doing but not in a paper." "Here," wrote Wallich, "is the lie direct given by himself to the statement."[56]

Even where he was correctly credited with the first published account of the coccospheres Wallich felt that his results were given less recognition than those of his rivals. His comment on Carpenter's account of the coccosphere story in the 1875 edition of *The Microscope* is typical.

> "To this is appended in Carpenter's book a figure of a Coccosphere which is conformable with Huxley's idea of what it should be, but is not in the least conformable with the real characters of the organism referred to. And yet the pack of cowards who dare not gainsay his dicta, even if he were to declare that a Coccosphere was like a turnip, have accepted his description and copied his caricature of a figure of a Coccosphere in every textbook on Biology. Of course they curried favour with him by totally ignoring my description and figures . . . just as they ignored, and to this day ignore, *both* Editions of "Notes on the Presence of animal life at vast depths in the sea", published on the [illegible] November and 19 December *1860*, and my letter in the "Annals" of 1st December [illegible]."[50]

Unlike Carpenter and Wyville Thomson, of course, Wallich survived to see all of the Official Reports of their greatest undertaking, the *Challenger* Expedition, published, though he could not have derived much pleasure from them. For his notebooks reveal that he scanned each of the volumes relevant to his own work as they appeared, but failed to find in them the recognition for which he craved. The specialist reports on the Foraminifera by Brady and on the Radiolaria by Haeckel inevitably came in for criticism, but the main targets for his attack were the volumes written by John Murray, whom Wallich referred to as "Wyville Thomson's wet nurse".

In 1895 the last of these volumes appeared, containing Murray's summary of all the *Challenger* scientific results and prefaced by his masterly resumé of the history of oceanography.

Murray referred extensively to Wallich's work, but far from satisfying him this only op up old wounds, since Sir John Ross's recovery of a starfish on the sounding line in 18 was attributed with at least as much significance in demonstrating the existence of life in the deep sea as Wallich's similar experience in the *Bulldog* in 1860. This same crime had, in Wallich's eyes, been perpetrated by Carpenter in the *Lightning* and *Porcupine* Reports and by Wyville Thomson in the *Depths of the Sea.*

"And now another culprit pretends to mete out even handed justice by patting his defaulting colleague on the back, falsifying my version of the facts and giving judgement about Sir John Ross having *proved* the existence of life at profound depths (which he w certainly very far from having done) whilst he (Murray), imagining me to be dead and beyond exposing his lies, lied in falsely casting discredit on my hard earned successes in supplying proofs. A more blackguardly and contemptible procedure there could not be

Whether or not Murray knew Wallich was alive when the Challenger summary volumes were published, he certainly did three years later when, on May 24th 1898, he was present at the annual meeting of the Linnean Society at which Wallich was awarded the Society's Gold Medal "in recognition of his researches into the problems connected with bathybial and pelagial life". One of Wallich's sons received the medal on behalf of his father, for the old man was unable or unwilling to attend the presentation. There is no indication of how he felt about the award, but it is likely that he thought it was too little and too late. In November 1898 he wrote this pathetic summary of his feelings-

"If any man ever was for forty years a victim of such a set of scoundrels, I am that man. I will prove my words to the letter and hope that I shall, by God's grace, still find means to carry out my earnest prayer."[58]

It is not clear what he intended to do. Presumably his detailed notes were to be the basis of an indictment of the "scoundrels" that would be so damning that the scientific community would finally have to recognise the justice of his case. But by now, and for many years past, the accumulation of the evidence had become such an obsession that he would probably never have considered his task complete. In any case, only four months later, on March 31st 1899, he died, bitter and frustrated to the end.

CONCLUSION

It is difficult to say whether Wallich was justified in feeling so much resentment towards the scientific establishment of his day and towards Carpenter and Wyville Thomson in particular. His early work, and especially that arising from the *Bulldog* cruise did not, perhaps, receive the recognition that it deserved, but on the other hand he seems to have lacked either the good fortune or the ability to carry any major task to a definite conclusion.

For instance, whether he liked it or not, while his "starfish" sounding produced a very strong indication that animals lived at great depths in the sea, it did not quite *prove* this. Similarly, although he took the loss of his naturalist's dredge on the *Bulldog* very seriously, so that "had it been made of gold, instead of the baser metal, the loss could hardly have been more keenly felt at the present time"[20], he did not pursue this line of enquiry to any great extent and Carpenter and Wyville Thomson could justifiably claim to be the main instigators of really deep dredging in the oceans. He made some valuable and original observations on the microscopic organisms which he encountered, and

particularly on the Foraminifera, the Radiolaria, the diatoms and the coccolithophores, but he did not carry them far enough and seemed unable to modify his early erroneous views in the light of subsequent findings.

Finally, he would almost certainly have progressed further up the scientific ladder if he had been a less prickly character, and less ready to take offence, and also if his literary style had been somewhat less cumbersome. For the combination of his verbosity and his egotism is a formidable deterrent to a serious consideration of his work, and it was almost certainly easier to dismiss his later works as those of a crank, rather than be drawn into his detailed and pedantic arguments.

In all things Wallich seems to have made a great deal out of very little. His sensitivity made him over-react to the words of others so that he could see a well-aimed blow in a casual remark, and at the same time he often extrapolated from his own results to draw conclusions which were hardly justified. But these conclusions were more often right than wrong, and perhaps his most fitting epitaph was written by Murray, one of his arch enemies, in the Summary volume of the *Challenger* Reports.

> "Many of Wallich's opinions have been confirmed by subsequent researches, and together he must be regarded as one of the most industrious pioneers in the investigation of the deep-sea".

ACKNOWLEDGEMENTS

We are grateful to the Librarians of the British Museum (Natural History), the Wellcome Institute of the History of Medicine, the Royal Society and the India Office of the Foreign and Commonwealth Office, for allowing us to examine and quote from documents in their care. We are particularly indebted to H. J. M. Symons of the Wellcome Institute and I. A. Baxter of the India Office for their help in our search for information.

Our thanks are also due to Wallich's relatives, Mrs. C. G. F. Wallich, Mr. F. L. Wallich and Mrs. L. Durham for their help in our unfortunately fruitless search for a portrait of G.C.W.

NOTES AND REFERENCES

[1] DEACON, M. 1971. *Scientists and the Sea 1650–1900.* London, pp. 445.

[2] THOMSON, C. Wyville. 1877. *The Voyage of the Challenger: the Atlantic.* London, 2 vols. 424 and 396.

[3] Seven manuscript notebooks by Wallich are in the Wellcome Institute of the History of Medicine, London, and are listed in S. A. J. Moorat's *Catalogue of Western Manuscripts on Medicine and Science in the Wellcome Historical Medical Library*, London, 1973. An eighth notebook is in the British Museum (Natural History).

The two libraries between them hold an almost complete set of Wallich's personal copies of his publications and also many papers by contemporary authors; all are copiously annotated by Wallich.

In addition, the British Museum (Natural History) possesses a collection of notes and drawings made during Wallich's voyages between Calcutta and Portsmouth, and also notes and drawings of ...mideae and Diatomaceae (*see* SAWYER, F. C. 1971. A short history of the libraries and a list of manuscripts and original drawings in the British Museum (Natural History), *Bull. Br. Mus. nat. Hist.* (hist. ser.), 4: 77–204). The set of notes and drawings made aboard HMS *Bulldog* in 1860, also listed by Sawyer, has not been located.

[4] Wallich receives the following entries in the *East India Register and Directory*

1840 Assistant Surgeon, 27.5.1838. Serving with 53rd Native Infantry, Loodhiana.
1841 Same service from 24.10.1839.
1842 53rd Native Infantry, Cabool.
1843 29th Native Infantry, Barrackpore.
1845 59th Native Infantry, Nenuch, 13.11.1843.
1847 2nd regiment, Irregular Cavalry, 16 3.1846, Lahore, in medical charge.
1848 2nd regiment, Irregular Cavalry, Hosheyarpore.
1849 2nd Irregular Cavalry, Punjaub.
1850 2nd Irregular Cavalry, Punjaub.
1851 on furlough
1852 unemployed. (4th senior among Assistant Surgeons, three men above him having ret promotion.
1853 Surgeon, 10.12.1851. 27th Native Infantry (volunteer) 2.2.1852, Burmah.
1854 Surgeon, 10.12.1851. 27th Native Infantry (volunteer) 2.2.1852, Barrackpore.
1855 50th Native Infantry, 11.9.1854, Benares.
1857 50th Native Infantry, 11.9.1854, Barrackpore.
1858 Furlough.
1859 Furlough.

[5] Wallich had married Caroline Elizabeth ? on 19 June 1851, during his previous visit to England His wife survived him and died at Bexhill on Sea, 28 May 1916. There were eight children: Charles Adrian Norton, b. 31 January 1854; Alice Mary, b. 16 October 1856, d. (unmarried) 28 February 1897; Beatrice Harriett, b. 3 May 1859, married 31 March 1891; Edith, b. 13 August 861, d. (unmarried) 26 July 1927; Elinor, b. 19 December 1862, d. (unmarried) 16 January 195 ollings, b. 4 March 1865; Marmaduke George, b. 6 September 1867; Horace, b. 28 November 18

Wallich was granted sick leave on 3 February 1857 and did not officially retire from the Army ntil 1 September 1859. From this time until his death he received an I.M.S. Pension of £191.12 a. and an additional £300 p.a. from 1 January 1863.

Information from the India Office Library, Foreign and Commonwealth Office.

[6] WALLICH, G. C. 1858. On microscopic objects collected in India etc. *Trans. Micr. Soc.*

[7] WALLICH, G. C. 1859. On apparatus for dredging at moderate depths in the sea and for captu ating objects from shipboard. *Q. J. Micr. Sci.*, 7: 1–4, p. 3.

[8] MAURY, M. F. 1853. Ocean soundings: the deepest of the deep sea soundings discussed. *Naut* g. (1853), 394–396.

[9] MAURY, M. F. 1858. *Explanations and Sailing Directions to Accompany the Wind and Current rts.* 8th Edition. Washington, Vol. 1, pp. 147–154.

[10] DAYMAN, J. 1858. *Deep sea soundings in the North Atlantic Ocean between Ireland and foundland, made in HMS Cyclops, in June and July 1857.* HMSO, London.

[11] In Wallich's copy of *The North Atlantic Telegraph via the Faeröe Isles, Iceland, and Greenla* eedings of the Royal Geographical Society of Great Britain. January 20th and February 11th, 1. London, 1861 (British Museum (Natural History)).

[2] DAYMAN, J. 1859. *Deep sea soundings in the North Atlantic Ocean between Newfoundland, Azores, and England, made in HMS Gorgon, in September and October 1858.* HMSO, London. AYMAN, J. 1860. *Deep sea soundings in the Bay of Biscay and Mediterranean Sea, made in Firebrand, in the summer of 1859.* HMSO, London.

[3] M'CLINTOCK, SIR F. L. 1859. *The Voyage of the Fox in the Arctic Seas, a narrative of the very of the fate of Sir John Franklin and his companions.* London, pp. 403.

M'Clintock had shown no particular interest in oceanography while serving in the arctic with mes Clark Ross in 1848–49, nor while he was with Capt. H. T. Austin and Sir Edward Belcher 50–54. But when the *Fox* was beset by ice in Baffin Bay in 1857–58, drifting southwards to Strait, he devised a formula for the drift using the direction and strength of the wind as well as rrent – a formula which produced an error of 270 miles in a drift of 835 miles.

M'Clintock's was not the only re-employment from the search for Franklin, for the telegraph ny purchased the *Fox* herself for the inshore surveys and the examination of landing places. e command of her to Capt. Allen Young, who had been M'Clintock's second in command

during the search for the rem the Hudson's Bay Company the Franklin search and wh proposed telegraph route.

[16] The *Bulldog* was built by coal which was consumed by For the 1860 cruise she had an marines. As first lieutenant M spending much of his time on west coast of Africa, and whe H. M. Burnett, had been master and Mediterranean. For surve Office, and two young master's M'Clintock's guest. (*Navy Lis* Vessel *Bulldog* 2 June 1860–

[17] MARKHAM, *Sir* Clemen

[18] The ship took 28 leads 6 pounds each for use in dep 118 pounds for the deeper so

[19] For use with the modi 96 pounds each and 15,000 f ich heavier than the cod-line 1861. *Remarks illustrative of*

[20] WALLICH, G. C. 1862. *board H.M.S. Bulldog, in 186 and nature of organic deposits.*

[21] M'CLINTOCK, F. L. 18 *1st July to 30th November 18* contains the following entries.

24.8.1860 "Mr. Rough actual trial and it answe
1.11.1860 "...... we
Dr. Wallich liv

[22] However, Wallich did ob December 11th 1860 (patent n

[23] Royal Geographical Socie log (ADM 53/7297 in the Publ indicated.

[24] MARKHAM, Sir C., *op.*

[25] Proc. Roy. Geog. Soc., 1

[26] Proc. Roy. Geog. Soc., 1

[27] MARKHAM, Sir C. *op.*

[28] Proc. Roy. Geog. Soc., 1

[29] MARKHAM, Sir C., *op.*

[30] Proc. Roy. Geog. Soc., 18

[31] M'CLINTOCK, F. L., 186

[32] WALLICH, G. C. 1860. and Francis, London. pp. 38.

Two editions of this pamphlet for private circulation only and presentation copies to the variou Museum (Natural History) Z60W for sale in the normal way.

during the search for the remains of the Franklin expedition. Young was accompanied by Dr. John Rae, the Hudson's Bay Company factor who had explored much of the coast of Canada before and during the Franklin search and who had volunteered his services to survey the overland portions of the proposed telegraph route.

[16] The *Bulldog* was built by Rennie and launched at Chatham in 1845. She carried 280 tons of coal which was consumed by the boilers of her 500 horse power engines at a rate of 1 ton per hour. For the 1860 cruise she had an establishment of 22 officers, 45 petty officers, 58 seamen and 20 marines. As first lieutenant M'Clintock took Charles Parry, second son of Sir Edward Parry, who after spending much of his time on half pay had recently been serving in the *Surprise*, a 4-gun sloop, on the west coast of Africa, and who was to return to half pay after the *Bulldog* voyage. The master, H. M. Burnett, had been master in the *Firebrand* with Dayman during the survey of the Bay of Biscay and Mediterranean. For surveying M'Clintock took T. W. Reed, an assistant from the Hydrographic Office, and two young master's assistants. Captain Conway Shipley, an admirable artist, went as M'Clintock's guest. (*Navy List* 20-12.1859 and 20.6.1860; PRO Adm 53/7296 Log book of HM Steam Vessel *Bulldog* 2 June 1860–26 December 1860).

[17] MARKHAM, *Sir* Clements, 1909. *Life of Admiral Sir Leopold M'Clintock,* London, pp. 254 -5.

[18] The ship took 28 leads for use in shallow water and weighing 28 pounds each, 28 leads weighing 56 pounds each for use in depths between about 200 and 1000 fathoms, and 75 iron sinkers weighing 118 pounds for the deeper soundings.

[19] For use with the modified Brooke's apparatus M'Clintock took 50 iron detaching weights of 96 pounds each and 15,000 fathoms of deep sea line, which at 22½ pounds per hundred fathoms was much heavier than the cod-line of which a hundred fathoms weighed only 4 lbs 5 oz. (M'Clintock, L. 1861. *Remarks illustrative of the sounding voyage of HMS Bulldog. in 1860.* London, pp. 12.)

[20] WALLICH, G. C. 1862. *The North-Atlantic Sea-Bed: comprising a diary of the voyage on board H.M.S. Bulldog, in 1860; and observations on the presence of animal life, and the formation and nature of organic deposits, at great depths in the Ocean,* London pp. 160, (p. 11).

[21] M'CLINTOCK, F. L. 1861., *op, cit.* But M'Clintock's *Journal kept in H.M.S. "Bulldog" 1st July to 30th November 1860* (National Maritime Museum, document McL/13. MS. 58/024) contains the following entries.

> 24.8.1860 "Mr. Roughton's apparatus brought up a teacup full of mud; this was its first actual trial and it answered well."
>
> 1.11.1860 ". . . . . . we used a new double scoop . . . . . . chiefly after the design by Dr. Wallich . . . . . . living microcosms were brought up from the bottom . . . . . . 870 fathoms."

[22] However, Wallich did obtain provisional cover on a patent for the sounding machine, dated December 11th 1860 (patent no. 3040).

[23] Royal Geographical Society Library, Ms 3, Mus 391/2. from this point onwards the *Bulldog* log (ADM 53/7297 in the Public Records Office) is the main source for the voyage unless otherwise indicated.

[24] MARKHAM, Sir C., *op. cit.* p. 256.

[25] Proc. Roy. Geog. Soc., 1861, p. 63.

[26] Proc. Roy. Geog. Soc., 1861, p. 65.

[27] MARKHAM, Sir C. *op. cit.*, p. 258.

[28] Proc. Roy. Geog. Soc., 1861, p. 66.

[29] MARKHAM, Sir C., *op. cit.*, p. 259.

[30] Proc. Roy. Geog. Soc., 1861, p. 67.

[31] M'CLINTOCK, F. L., 1861, *op. cit.*, p. 10.

[32] WALLICH, G. C. 1860. *Notes on the presence of animal life at vast depths in the sea.* Taylor and Francis, London. pp. 38.

Two editions of this pamphlet were published. The first, which appeared on November 20th, was for private circulation only and was, according to Wallich's notes on his own copy, forwarded "as presentation copies to the various scientific societies and men in Great Britain and abroad" (British Museum (Natural History) Z60W). The second edition, published on December 19th, was produced for sale in the normal way.

[33] FORBES, E. and GODWIN-AUSTEN, R. 1859. *The Natural History of the European Seas*, London. pp. 306.

[34] WALLICH, G. C., 1862, *op. cit.*

[35] *See also* RICE, A. L. 1975. The oceanography of John Ross's Arctic Expedition of 1818; a re-appraisal. *J. Soc. Biblphy Nat. Hist.* 7: 291–319.

[36] In *Physical Geography*, published in 1851, Mary Somerville had confused the two Rosses and had wrongly credited James Clark Ross with the 1000 fathom "starfish" soundings.

[37] THOMSON, C. Wyville. 1873. *The Depths of the Sea*, London.

[38] British Museum (Natural History) (see note 3 above).

[39] WALLICH, G. C., 1862, *op. cit.*, pp. 68–69.

[40] THOMSON, C. Wyville, 1873, *op. cit.*, p. 272.

[41] *Ibid*, p. 30.

[42] Up to this time Wallich seems to have had no particular opinion for or against Wyville Thomson, while he seems to have had considerable respect for Carpenter. Certainly his references to Carpenter's work on protozoan classification in the third and unfinished part of *The North Atlantic Sea-Bed* (General observations on the deep-sea rhizopodal fauna, pp. 156–160) are very complementary.

[43] *In* DAYMAN, J. 1858, *op. cit.*

[44] OWEN, S. 1865. On the surface fauna of mid-ocean. *J. Linn. Soc.* 8: 202–205, and 1868, *J. Linn. Soc.* 9: 147–157.

[45] THOMSON, C. Wyville. 1874–1875. Preliminary notes on the nature of the sea-bottom procured by the soundings of H.M.S. *Challenger* during her cruise in the 'Southern Sea' in the early part of the year 1874. *Proc. R. Soc. Lond.* 23: 32–49.

[46] CARPENTER, W. B. 1874–1875. Remarks on Professor Wyville Thomson's preliminary notes on the nature of the sea-bottom procured by the soundings of H.M.S. *Challenger*. *Proc. R. Soc. Lond.* 23: 234–245.

[47] WALLICH, G. C. 1876. *The Biology of Globigerina*, London, pp. 73, (p. 21).

[48] Ibid, p. 43.

[49] Royal Society correspondence.

[50] Notebook no. 8, British Museum (Natural History) (*see* note 3 above).

[51] Nevertheless one of his most amusing notes (in notebook No. 5) refers to Carpenter's modified view of *Globigerina* biology:–

". . . . But to make sure of being right under *all* circumstances, Fur *hedged* his statements by declaring that the Glob are *pupped* on the sea-bed, and he believes their father and mother perform the conubial fandango down in their muddy bed – that the youngsters at once climb up (with the aid of Sargasso – made ladders) to the surface – where they are educated, see the world, flirt with women, grow fat and unwieldy, perhaps do a little procreative business by way of keeping their tools sharp, and then retire from the surface, sated with life and its upper crust frivolities, and sink down to the bottom to play at male and female – and so on *ad infinitum*. Verily Fur is fertile in resource, a very master of fabrication, and blest beyond the worst of ordinary mortals, by having inherited no conscience whatsoever."

[52] HUXLEY, T. H. 1868. On some organisms living at great depths in the North Atlantic Ocean. *Q. J. microsc. Sci.* 8: 203–212.

[53] WALLICH, G. C. 1861. On some novel phases of organic life and the boring powers of minute annelids. *Ann. Mag. nat. Hist.* Ser. 3 (8): 52–58.

[54] SORBY, H. C. 1861. On the organic origin of the so-called "Crystalloids" of the Chalk. *Ann. Mag. nat. Hist.* Ser 3, Vol. 8: 193–200, p. 196.

[55] THOMSON, C. Wyville. 1873. *The Depths of the Sea*, p. 413.

[56] H. Barwell Turner (Brewer) of 8 Corn Exchange, Leeds.

[57] Wallich notebook no. 5, Wellcome Institute of the History of Medicine (*see* note 3 above).

[58] Wallich notebook no. 4, Wellcome Institute of the History of Medicine (*see* note 3 above).

J. Soc. Biblphy nat. Hist. (1976) 7 (4):

James Parkinson's Org
(1804-1811)

By J. C. THACKRAY

Institute of Geological Sciences,
Exhibition Road,
London, S.W.7.

INTRODUCTION

James Parkinson was born in Hoxto
He followed his father as a surgeon
Hoxton Square. He wrote a numbe
as the more serious *Observations on*
Essay on the shaking palsy (1817).
for political reform, being a membe
of a number of anonymous and pse
and published a very popular pocke
collector of fossils and minerals and
of fossils. This paper examines the
evolution of his ideas through the y
editions of his most famous book,

BIOGRAPHICAL BACKGROUND

It was study of a copy of *Chemica*
that first turned Parkinson's attent
and mining, volcanoes and the orig
subjects would surely have been en
(dates unknown), dedicatee of *Org*
great surgeon. Welch, who was be
theory of the Earth in 1821,[3] whi
in 1785,[4] was an enthusiast for ge

Whatever the origin of his inter
collection of rocks, minerals, and f
of eighteen natural history sale cat
preserved in the Zoology Library
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increasing spending power. The fi
specimens, including a fossil alligat
the sum of £5.3.6d,[6] while the Ra
chase of the mastodon tooth figur
years he acquired specimens from
(1739–1799), Charles Alexandre
Bute (1712–1792), John Strange

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AUTH
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